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Those interested in plant physiology and plant chemistry will find this little book of great value on account of the many positive facts stated and because of the critical way in which the author has attempted to organize these facts. Some of the hypotheses may be more sweeping than the facts warrant, but they should serve to stimulate work on these important but difficult problems.—CHAS. O. APPLEMAN.

MINOR NOTICES

Michigan trees.—The first thing that recommends this little manual[2] to the student of trees is its convenient pocket size (5 by 7.5 inches), which makes it more readily useful in the field than more pretentious volumes. A closer examination reveals the fact that it is well illustrated by carefully made drawings of the leaves, flowers, buds, and fruit of each species. The keys seem to have been constructed with more than usual care, and are in duplicate, one based largely upon the leaves, for use during summer; and a second making use of the bud and twig characters as a basis of identification during the winter. In order that the bulletin may appeal to as large an assemblage of readers as possible, the use of technical terms has been reduced to a minimum, and those necessarily employed are fully explained in a glossary. The arrangement of drawings and descriptions of species upon pages facing one another adds to the ease with which the manual may be consulted.—GEO. D. FULLER.

NOTES FOR STUDENTS

Mutations and inheritance in Oenothera.—DAVIS[3] has recently reported a continuation of his studies of *Oenothera*. In previous papers[4] he has described the F_1 and F_2 generations of hybrids between *O. biennis* and *O. grandiflora*. The present account deals with the behavior of F_2 and F_3 generations of the same or similar hybrids. The data presented are discussed (1) from the standpoint of their bearing upon the origin and habit of mutation of *O. Lamarckiana*, and (2) with relation to their possible interpretation by Mendelian principles of inheritance. The latter, if one may judge from the methods employed in these studies, has been incidental to the former. The primary purpose of the investigations has been to determine the possibility of the synthesis through hybridization of a type similar in both taxonomic features and mutating habit to *O. Lamarckiana.* The results are summarized briefly as follows: "I have not been able to synthesize by direct crosses, from wild stock so far obtained, any hybrid with all of the characters of *Lamarckiana* in the same plant, although I believe that all of the important taxonomic characters of *Lamarckiana* have been represented in some of my hybrids. . . . . The resemblance of my various hybrids to *Lamarckiana* and the parallelism of their behavior in the F_2 and F_3 to that of *Lamarckiana* give in themselves sufficient reasons, in my opinion, to justify the belief in its hybrid character and to point to the probability that this plant arose as a cross between distinct forms of *Oenothera. Lamarckiana* thus would not be representative of a wild species of essentially stable germinal constitution and its mutations are most simply interpreted as the behavior of a hybrid." Prominent among the types that appeared in F_2 and again in F_3 and bred true in a later generation—this behavior constituting the similarity to the mutation habit of *O. Lamarckiana*—were dwarf forms with narrow etiolated foliage, and somewhat similar dwarf forms with normal green foliage. These forms occurred in approximately 10 per cent and 15 per cent of their respective families. Other striking forms were a *semigigas* type with at least 21 chromosomes, and a form similar to *O. elliptica.*

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[2] OTIS, CHARLES H., and BURNS, G. P., Michigan trees. 12mo. pp. xxxii+246. *figs. 120.* Ann Arbor: Univ. Mich. Bull. N.S. **14**: no. 16. 1913.

[3] DAVIS, B. M., The behavior of hybrids between *Oenothera biennis* and *O. grandiflora* in the second and third generations. Amer. Nat. **47**:449–476, 547–571. 1913.

[4] ———, Notes on the behavior of certain hybrids of *Oenothera* in the first generation. Amer. Nat. **44**:108–115. 1910; Some hybrids of *Oenothera biennis* and *O. grandiflora* that resemble *O. Lamarckiana*. Amer. Nat. **45**:193–233. 1911; Further hybrids of *Oenothera biennis* and *O. grandiflora* that resemble *O. Lamarckiana*. Amer. Nat. **46**:377–427. 1912.

With relation to a possible Mendelian interpretation of his results, DAVIS' most troublesome problems are: (1) "the explanation of the large groups of dwarfs thrown off in the F_2 generations and repeated by certain plants in the F_2," and (2) "the explanation of the well-defined progressive evolution, excluding the dwarfs, exhibited by these same cultures." This "progressive evolution" consisted in the appearance of F_2 families whose flower size ranged from about 1 cm. greater than that of the large-flowered parent (*grandiflora*), to about twice as large as that of the small-flowered parent (*biennis*), and in a corresponding increase in size and amount of crinkling of the leaves. DAVIS doubts the possibility of explaining this advance in flower size on the basis of a recombination of size factors as suggested by the multiple-factor hypothesis, because there was in these families no balancing group with flowers smaller than the small-flowered parent, and he inquires: "What had become in these cultures of the factors responsible for small size?" When it is noted, however, that at least one F_2 family exhibited pronounced "retrogressive evolution" in flower size, little difficulty will be experienced by students of the inheritance of quantitative characters in interpreting DAVIS' results by means of the multiple-factor hypothesis. The obvious suggestion is that the several F_1 plants tested had somewhat different combinations of size factors, that is, that one or both of the parents were heterozygous with respect to a few quantitative factors, a condition which could scarcely be detected under the masking effect of ordinary fluctuation without resort to a careful quantitative study of several lines of progenies of the plants used as parents of any hybrid.

The dwarf plants in certain F_2 and F_3 cultures are also inexplicable to DAVIS on the basis of a recombination of size factors, and with this the reviewer is inclined to agree. The dwarfs are much smaller than the parents, the gap between them and the parents or the smallest of other F_2 forms is not bridged, and there are no compensating giant forms. It seems more likely that these plants are dwarfs because of some abnormality of function, and that, so far as size factors are concerned, they may be potentially tall. One group in fact is characteristically etiolated. The abnormalities, however, may well be due to a recombination of other genetic factors present in the parents. The fact that the dwarfs have occurred in some cultures in ratios much above 1:15 need occasion little worry at the present stage of the investigations, since students of genetics are coming to look to ratios merely for indications, and to base conclusions rather upon a factorial analysis of the material, worked out by intercrosses of the diverse types of the culture concerned or by back crosses with the parents.

DAVIS' results as a whole are of the greatest importance. It is hoped that he will find the time in the near future to subject his material to statistical and factorial analysis in the same painstaking way that has given the brilliant results secured in his attempted synthesis of *Oenothera Lamarckiana.*

HERIBERT-NILSSON[5] has reported the results of a study of *Oenothera Lamarckiana* and its derivatives. His cultures exhibited numerous heritable differences with regard to such characters as color of leaf veins and leaf blades, breadth of flowers, length of fruits, and height of plants. The appearance of these minor forms in cultures of *Lamarckiana* is regarded as an indication that the species is not a constant one. The characteristics by which these forms are distinguished are the same, in part at least, as those that serve to differentiate the mutations of *Lamarckiana.* This fact suggests to the author that the mutations are the result of new combinations of characters, or factors, present in the parent species.

The mutations that appeared in HERIBERT-NILSSON'S cultures were not identical with those of DE VRIES. Some of them were entirely unlike DE VRIES' mutations, while others were parallel types. Some of the latter resembled *rubrinervis, gigas, albida,* and *lata,* for instance, in certain respects, but differed from them in others. Certain of the author's mutants combined important characteristics of several of DE VRIES' mutants. One, for instance, exhibited characters of *rubrinervis, scintillans,* and *lata.* The forms studied differed principally in quantitative characters, a fact that makes a factorial analysis a matter of extreme difficulty. The behavior of certain qualitative characters, particularly red color of leaf veins, indicated that two or three Mendelian factors might be concerned. Ratios of red-veined to white-veined individuals occurring in the F_3 generation of a giant form approached 3:1, 15:1, and 63:1. A complete factorial analysis of these groups, based upon a study of their progenies, has apparently not as yet been attempted. HERIBERT-NILSSON'S suggestion that giant (*gigas*-like) oenotheras have arisen through the combination of numerous independent size factors is criticized by GATES[6] (1) on the basis of cytological evidence (tetraploid chromosomes) to the contrary, and (2) on the basis of their sudden, discontinuous origin.—R. A. EMERSON.

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[5] HERIBERT-NILSSON, H., Die Variabilität der *Oenothera Lamarckiana* und das Problem der mutation. Zeitsch. Ind. Abst. Vererbungs. **8**:89–231. 1912.

Araucarians.—Miss HOLDEN[7] has recently described the stems of two fossil plants from eastern Canada, a *Tylodendron* from the south shore of Prince Edward Island and a form which she claims is *Voltzia coburgensis* from the Triassic at Martin's Head, New Brunswick. She has identified her specimens by the casts of the pith, and by the structure as well, and uses her determinations as evidence of the geological horizon of the strata in which they are found. In this connection, she states: "Since *Tylodendron* is characteristic of the Permian, there can be no question that these strata [those of Prince Edward Island] are of that age"; and of *Voltzia:* "Paleobotanical evidence indicates that the Mesozoic strata of New Brunswick are of the same age as those of the eastern United States, and should be correlated with the Lettenkohle or Lower Keuper of Europe." The pith casts of her *Tylodendron* are typical, and she states of the ligneous structure: "It agrees exactly with that described by DAWSON from Mr. BAIN's specimen as *Tylodendron Baini*, and with that described by POTONIÉ as *Araucarioxylon rhodeanum* Goepp."

In discussing the evidence for and against the generally accepted view of the araucarian affinity of *Tylodendron*, a view, however, from which Miss HOLDEN dissents, she agrees with POTONIÉ that "the nodal swellings and instanding protoxylem strands causing the ridges and furrows of the pith casts are identical with similar structures in *Araucaria* and *Agathis*," but states that instanding protoxylem strands are common to all living conifers. She admits that the medullary rays are typically araucarian, the rays uniseriate, rarely over 10 cells high, and composed of thin-walled cells, but she says that all conifers have uniseriate rays. Neither of her arguments, however, precludes the araucarian connection. Of the tracheary pitting, she says: "Its closely compressed and alternating pits clearly affiliate it with *Araucarioxylon* Krauss," but she considers that this does not indicate araucarian affinity, since "closely compressed and alternating pitting is not the primitive condition for the Araucarineae." This statement is made on the authority of Professor JEFFREY's[8] recent work. While both of these articles were in press, however, the writer[9] advanced evidence

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[6] GATES, R. R., Tetraploid mutants and chromosome mechanisms. Biol. Centralbl. **33**:92–99, 113–150. 1913.

[7] HOLDEN, Miss R., Some fossil plants from eastern Canada. Ann. Botany **27**: 243–255. 1913.

[8] JEFFREY, E. C., The history, comparative anatomy, and evolution of the *Araucarioxylon* type. Proc. Amer. Acad. **48**:531–571. 1912.

[9] THOMSON, R. B., On the comparative anatomy and affinities of the Araucarineae. Phil. Trans. Roy. Soc. B **204**:1–50. 1913.